REMARKS

Claims 1, 2, 8-11, 14, 17 and 23 have been amended. Claim 4 has been cancelled. Claim 1-3 and 5-24 are now pending in the application. Support for any changes and additions can be found throughout the application as originally filed. As such, no new matter has been presented. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the amendments and remarks contained herein.

INFORMATION DISCLOSURE SHEET

The Examiner contends that the Information Disclosure Sheet filed on 20 December 2005 fails to comply with 37 C.F.R. § 1.98(a)(3). Applicants are submitting herewith a Supplemental Information Disclosure Statement in compliance with 37 C.F.R. 1.98(a). The Supplemental Information Disclosure Statement identifies the three references that the Examiner did not consider. English language translations of the respective abstracts are provided.

Applicants respectfully request the Examiner to consider the identified refrences and return the appropriate acknowledgement.

CLAIM OBJECTIONS

Claim 8 stands objected to as failing to terminate in a period. Claim 8 has been corrected. Applicants submit that the claim objection has been overcome.

Rejection Under 35 U.S.C. § 112

Claims 9-11, 14, 20, 21, 23 and 24 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point and distinctly claim the subject matter which Applicant regards as the invention. Applicant notes that neither the term "layers" nor the term "converter layers" is found in claims 20, 21 and 24. Applicant has otherwise amended the claims in view of the § 112 rejections and respectfully submit that these rejections have been traversed.

Objections To The Drawings

The drawings are objected as failing to comply with 37 C.F.R. 1.84(p)(5). More particularly, the Examiner contends that element 11 in Figure 4 is not mentioned in the description. Reference character 11 has been removed from Figure 4. As such, the objection to the drawing is now moot.

Rejections Under 35 U.S.C. § 102 and § 103

Claims 1-24 stand rejected under 35 U.S.C. § 102 and/or § 103. More particularly, claims 2, 4, 6, 16 and 18 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kitaguchi et al. (U.S. Pat. No. 5,321,269; published June 14, 1994). Claims 1, 3 and 4 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Justus et al. (U.S. Patent No. 5,656,815; published August 12, 1997). Claims 1 and 10 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Morton (U.S. Pat. No. 5,693,947; published December 2, 1997). Claims 1 and 22 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Barthe et al. (U.S. Patent No. 5,406,086).

Claims 1, 5, 7, 8, 11 and 12 stand rejected under 35 U.S.C. § 102(b) as being anticipated by McGregor et al.; published November 22, 2002). Claim 9 stands rejected under 35 U.S.C. § 102(a) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over McGregor et al. ("Design considerations for thin film coated semiconductor thermal neutron detectors – I: basics regarding alpha particle emitting neutron reactive films," published November 22, 2002). Claims 13, 23 and 24 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Kitaguchi et al. (U.S. Patent o. 5,321,269; published June 14, 1994) as applied to claim 1 and further in view of Burgkhart et al. (U.S. Patent No. 4,492,872; published January 8, 1985). Claims 14 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over McGregor et al. ("Design considerations for thin film coated semiconductor thermal neutron detectors – I: basics regarding alpha particle emitting neutron reactive films," published November 22, 2002) in view of Barthe et al. (U.S. Patent No. 5,406,086; published April 11, 1995). Claim 17 stands rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Kitaguchi et al. (U.S. Patent No. 5,321,269; published June 14, 1994). Claims 19-21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Kitaguchi et al. (U.S. Patent No. 5,321,269; published June 14, 1994) as applied to claim 1, and further in view of Tawil et al. (U.S. Patent No. 5,572,027; published November 5, 1996). These rejections are respectfully traversed for the reasons set forth herein.

The dosimeter according to the invention enables an efficient conversion and detection of neutrons in a wide neutron energy range, i.e. of low-energy neutrons, fast neutrons and high-energy neutrons. The dosimeter according to amended claim 1 can

be used essentially in the entire energy range of neutron radiation, ranging from thermal neutrons (0.025 eV) up to the highest energies in the range of GeV or higher, for instance up to 1 TeV.

The metal atoms essentially convert the high-energy neutrons to be detected into protons, alpha particles and charged particles. There exists no sharp distinction between low-energy, fast and high-energy neutrons for each range. In general, neutrons of an energy above 20 MeV can be described as high-energy neutrons. The response capability of common types of dosimeters for neutrons of an energy above 20 MeV is very low. The response capability decreases with increasing neutron energy. One of the reasons for this effect is the decrease in the interaction cross section. Particularly, said metal atoms have an atomic number of $Z > 15$.

The hydrogenous material, for instance a polymer, essentially converts said fast neutrons to be detected into protons. Fast neutrons in the energy range between several 100 keV and several 10 MeV can be efficiently verified in such a hydrogenous material. Essentially, elastic scattering of the high-energy neutrons with the protons from the hydrogenous material takes place.

The material suitable to cause a (n, α) reaction and/or a (n, p) reaction converts essentially said low-energy neutrons, including also thermal neutrons, into protons and/or alpha particles. Also, back-scattered neutrons can be converted. In general, neutrons of thermal energy up to an energy of several 100 keV can be described as low-energetic. Possible examples for a material suitable to cause an efficient (n, α) reaction and/or (n, p) reaction to convert said low-energy neutrons to be detected into protons and/or alpha particles comprise ^{6}Li atoms and or ^{10}B atoms and/or ^{14}N atoms.

Independent claim 1 has been amended to even more clearly define the subject invention. In this regard, claim 1 now recites that the metal atoms are stable in the sense of radioactivity and that the neutron converter includes:

> - a hydrogenous material which converts said fast neutrons to be detected into protons;
> - a material suitable to cause a (n, α) reaction and/or a (n, p) reaction to convert said low-energy neutrons to be detected into protons and/or alpha particles; and
>
> (b) a detection element for detecting and registering said protons, alpha particles and charged particles as produced by said three converting processes.

Amended claim 1 further recites that the dosimeter is operative for detecting high-energy, fast and low-energy neutrons. U.S. Patent No. 5,321,269 (Kitaguchi, et al.) describes a neutron individual dose meter and a neutron dose rate meter. The neutron individual dose meter includes a composite layer made up of a converter such as boron, and a protron radiator, on the surface of a semiconductor neutron detection element. There have been provided: a neutron detector having a layer comprising a first material which emits charged particles through a nuclear reaction with incident <u>thermal neutrons</u> and a second material which emits charged particles through interactions with incident <u>fast neutrons</u>, the same layer being bonded on the surface of a semiconductor detection element; a processing circuit for processing signals obtained from the neutron detector; and a power source for supplying power to the neutron detector and the processing circuit. The range of energy includes a region for thermal neutrons having energy in the thermal neutron region <u>below 0.5 eV</u>, to fast neutrons ranging above <u>0.5 eV up to 10 MeV</u>.

Kitaguchi et al. does teach nor suggest a dosimeter for detecting high-energy, fast and low-energy neutrons. In particular, Kitaguchi et al. does not teach nor suggest

a dosimeter comprising metal atoms which convert high-energy neutrons to be detected into protons, alpha particles and charged particles in a suitable energy range and wherein said metal atoms of the neutron converter are stable in the sense of radioactivity as recited by amended claim 1.

In U.S. Patent No. 5,656,815 (Justus, et al.) radiation is detected using a light transparent themoluminescent dosimeter that comprises a nanocrystalline phosphor dispersed in a light transparent glassy matrix, such as Vycor glass. The dosimeter is placed in an environment in which radiation is present for a period of time, removed from the environment and then heated to emit light, the intensity of which is indicative of the radiation dose. In one embodiment, TL phosphors suitable for use in the practice include zinc sulfide (ZnS), doped with one or more activating metal ions such as Cu (ZnS:Cu), Mn, Ag, Pb and Eu, Lithium fluoride, doped with one or more activating metal ions such as Ti and Mg (LiF:Ti, Mg) and also Cu or P. Lithium borate doped with Mn ion ($Li_2B_4O_7$:Mn) is known to be useful for X-ray and neutron detection.

Justus et al. does not teach nor suggest a dosimeter for detecting high-energy, fast and low-energy neutrons. In particular, Justus et al. does not teach nor suggest a dosimeter comprising metal atoms which convert high-energy neutrons to be detected into protons, alpha particles and charged particles in a suitable energy range recited by amended claim 1.

U.S. 5,693,947 (Morton) relates to radiation detectors. The radiation detector has a dual-capacitive structure comprising an array of first capacitors including discrete electrodes arranged in rows and columns and a second capacitor. The second capacitor incorporates a radiation converter which cooperates with the first capacitors to

cause an accumulation of charge on the discrete electrodes according to the spatial distribution of radiation to which the radiation converter is exposed. Read-out means is provided to output a signal representative of the accumulated charge. It is described that the radiation converter may take a variety of different forms depending upon the application to which the radiation detector is being put, including converters incorporating: Metal foils with high neutron interaction cross-section in contact with a device of type for instance semiconducting polymers. Such converters could be used to detect neutrons.

Morton does not teach nor suggest a dosimeter for detecting high-energy, fast and low-energy neutrons. In particular, Morton does not teach nor suggest metal atoms which convert said high-energy neutrons to be detected into protons, alpha particles and charges particles.

U.S. Patent No. 5,406,086 (Barthe, et al.) shows a particle dose rate meter. A radiation dose rate meter is provided which includes a diode for sensing radiation, and an electric measuring circuit divided into two branches having different frequential filters, one filter for measuring alpha particles, protons and neutrons and another filter for measuring electrons and photons (i.e., particles that deliver differently shapes pulses of upon reaching the diode). The dose rate meter is able to accurately determine the dosage of radiation effectively received.

Barthe, et al., does not teach nor suggest a dosimeter wherein the neutron converter comprises metal atoms. As such, the shown particle dose rate meter is not suitable for detecting high-energetic neutrons.

The publication (NIM A 500, (2003) 272-308, McGregor, et al.) relates to design considerations for thin film coated semiconductor thermal neutron detectors. Such devices can be produced by coating semiconductor-charged-particle detectors with neutron reactive films that convert free neutrons into charges particle reaction products. Used reactions are ^{10}B (n, α) ^{7}Li and ^{6}Li (n, α) ^{3}H.

McGregor et al. does not teach nor suggest a dosimeter suitable for measuring high-energetic neutrons and/or fast neutrons.

U.S. Patent No. 4,492,872 (Burgkhart, et al.) shows an albedo dosimeter encapsulation.

U.S. Patent No. 5,572,027(Tawil, et al.) describes an integrated dosimeter for simultaneous passive and active dosimetry.

Burgkhart et al. and Tawil et al. do not provide any hint to the present invention as defined in amended claim 1.

The devices for neutron radiation detection described in the above cited state of the art documents correspond to common dosimeters which have been developed previously for areas of nuclear technology (for instance nuclear reactors) which permit measurements for maximum neutron energies of about 10 to 20 MeV.

For the reasons set forth above, Applicant respectfully submits that the present invention defined by amended claim 1 is patentable over the collective art of record. Accordingly, claim 1 and claims 2, 3 and 5-24 dependent therefrom are in a condition for allowance.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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By: ______________________

Stephen T. Olson
Registration No. 36,626
Attorney for Applicant

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303
(248) 641-1600

STO/kgg